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Effect evaluation of an oral health education programme in primary schools in Tanzania

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Abstract – This study aimed to assess the clinical oral health outcome effects among schoolchildren participating in a school-based oral health education (OHE) programme. Local social, cultural and environmental conditions were determinants of the school-based OHE programme, which was compiled on the basis of prevailing beliefs and on what teachers and educational authorities considered to be important for the oral health of schoolchildren. Consequently, the practical aspects of oral hygiene and information on the cause and prevention of caries and gingivitis were the components of oral health education. The teachers were prepared to carry out weekly supervised toothbrushing sessions and monthly lessons on aspects of oral health for the school year in grade 4. Eight participating schools were selected for the clinical effect evaluation and four non-participating schools served as the control. In total, 309 children from the participating schools and 122 children from the non-participating schools were available for the evaluation. Their ages varied between 9 and 14 years. The mean plaque score, calculus score and gingival bleeding score at baseline and at follow-up examinations 3, 8, 15 and 36 months later were not significantly different for participating schools and controls. The mean DMFT value at baseline was 0.4 and 3 years later 0.9 in both the participating and control schools. In conclusion, the present study shows that the implemented school-based OHE programme did not result in significant reductions of the clinical parameters measured.

Key words: calculus; caries; dental plaque; gingival bleeding; oral health education

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In contrast to the industrialized countries, virtually nothing is known about the effectiveness of school-based oral health education (OHE) in the non-industrialized sub-Saharan African countries where the prevailing social, cultural and environmental factors are quite different. The few studies on oral health education in schools in sub-Saharan African countries had in common that oral health education was provided by dental professionals for a short time only without later reinforcement; effect evaluation was limited to caries increment (1, 2).

A low budget OHE programme for primary schools was designed and implemented in Morogoro to increase children's awareness of oral health risks and to provide them with the knowledge, skills and attitude required to avoid the preventable oral diseases, as formulated in Tanzania's national plan for oral health (3). Local beliefs and habits regarding oral health, people's financial means, lack of government resources, school system and environmental conditions were determinants of the present school-based OHE programme.

This study aimed to evaluate the clinical

outcome effects of oral hygiene and caries among schoolchildren participating in the school-based OHE programme.

Material and methods

Demography

This study was carried out in Morogoro, some 200 kilometers inland, west of the capital Dar es Salaam in Tanzania. Morogoro is a semi-industrial fast-growing town with over 100 000 inhabitants in 1989 at the start of the study. There is a small university and several

other educational institutions. The town is served by a regional hospital which incorporated at that time the only dental clinic. Before the study started, no school-based oral health education existed in Morogoro.

Prevailing oral health conditions, beliefs and habits

Water supplies in town contain 0.02 to 0.2 mg/L fluoride (4). Magadi, a food additive that may have a high fluoride content (5) is not consumed in Morogoro town. The mean daily intake frequency of candy, fruits and sweetened beverages among children was 5.2 in 1984 (4). Some kind of oral hygiene is practised by many children. A minority use a chewing stick but most have a toothbrush (6), although it is usually worn out, because a new one is barely affordable. Toothpaste is infrequently used and at the time of the study did not contain fluoride. Awareness of the need for treatment and the use of oral health care services are limited and strongly related to pain experiences (7). Demands for preventive treatment are uncommon in Morogoro (8).

The OHE programme

First, an interview was conducted among teachers and educational authorities to explore their beliefs and knowledge pertaining to oral health and to understand what they consider important for the oral health of schoolchildren. The interviewees appeared to have limited knowledge about the cause and prevention of caries and gingivitis. The oral hygiene of schoolchildren was considered important and this subject took a prominent place among the issues most frequently raised (Table 1). It

was consequently decided that the practical aspects of oral hygiene should be part of the OHE programme and that the cause and prevention of caries and gingivitis should be included and emphasized.

A 1-day workshop was organized for the headteacher and one teacher in charge of health education of each of 19 of the total of 23 primary schools in Morogoro. Four schools did not participate and it was explained that they served as the control for the effect evaluation. People from radio and newspapers (no television in Tanzania in 1989) were invited and attended the seminar. Next day the seminar was mentioned on radio and in the newspapers. The seminar started with an explanation of the rationale of a school-based OHE programme and the teacher's role as 'gatekeepers' of children's health. Prevailing oral health problems were demonstrated with the schoolchildren as live models. The impact of a large variety of local foods and sweets on oral health was discussed, with special emphasis on the local custom of sugar cane chewing. Many children go without breakfast and derive part of their energy requirement during schooltime from chewing sugar cane. Since these children of poor families have no alternative, sugar cane chewing was not blamed. Besides, sugar cane chewing is not a great risk for dental health (9). In answer to a request for a simple guideline, it was explained that up to four sugary snacks were not considered detrimental to dental health.

The presence of plaque was demonstrated in the children's mouths and the benefits of good oral hygiene were emphasized. Since it was decided to implement school toothbrushing sessions under the supervision of the teacher, effective toothbrushing was demonstrated in the child's mouth. It was explained that many methods of brushing are effective,

but for children a horizontal short-stroke brushing method along the marginal gingiva was advocated. Because a large majority of teachers believed the toothbrush to be superior to the chewing stick it was emphasized that both tools are equally effective in tooth-cleaning. Since the teachers had to supervise the toothbrushing of a whole class of children, a systematic method of toothbrushing was demonstrated in order to ensure a step-by-step control and to promote brushing of all tooth surfaces. The brushing started on the upper-right palatal sites, then the upper-front palatal sites and the upper-left palatal sites. Subsequently the upper-right buccal sites, upper-front buccal sites and upper-left buccal sites, and thereafter, in the same sequence, the mandibular teeth and finally the occlusal surfaces were brushed. The use of toothpaste in school toothbrushing sessions was considered impractical. The teachers practised the supervision of a group of toothbrushing children so as to mimic the future situation in their schools. After discussion with the teachers about practical problems, it was decided that weekly toothbrushing sessions and monthly lessons on the cause and prevention of caries and gingivitis would fit in the school curriculum of grade 4 during the ongoing school year. Since there is a rich tradition of songs, drama and dance in schools in Tanzania and because this has a great appeal to children, application of these methods for the monthly OHE lesson was discussed with the teachers.

The parents of grade 4 pupils were informed by a letter from the headteacher. Emergency dental care on demand was rendered to the teachers and the grade 4 children.

Study design

From each quarter section of the town, the first two randomly selected schools were assigned as participating schools for the assessment of the clinical outcome effects ($n=8$). The third school randomly selected from each quarter section was assigned as a non-participating school to serve as control ($n=4$). During the first 3 months after the workshop, the eight selected partici-

Table 1. Issues mentioned by the interviewees before the start of the OHE programme

1. The effectiveness of the traditional chewing stick for cleaning teeth
2. The frequency and duration of toothbrushing
3. The use of toothpaste and other commodities as cleaning aids
4. The cause of bad breath
5. The cause of black teeth (fluorosis)
6. The influence of food (lack of vitamins) on gingivitis
7. Requests for emergency care to relieve pain
8. The practice of traditional healers who remove the tooth germ of primary canines in order to cure the infant of diarrhoea and fever

Table 2. Mean (\pm SD) plaque, calculus and gingival bleeding scores at baseline and increment scores ($-$ or $+$) at follow-up examinations

Schools	Baseline	3 months	8 months	15 months	36 months
Plaque					
Experimental ($n=8$)	20.5 \pm 1.2	-4.6 \pm 2.2	-3.4 \pm 1.6	-3.0 \pm 2.3	-4.3 \pm 2.5
Control ($n=3$)	18.9 \pm 0.4	-2.1 \pm 1.7	-0.7 \pm 0.8	-0.9 \pm 1.1	-3.0 \pm 0.5
Student's t value ($n=9$)	2.19 NS	1.79 NS	2.73*	1.48 NS	0.88 NS
Calculus					
Experimental ($n=8$)	4.7 \pm 1.0	-0.7 \pm 0.4	-1.1 \pm 0.6	-0.4 \pm 0.4	-0.02 \pm 0.4
Control ($n=3$)	4.5 \pm 0.1	-0.7 \pm 0.2	-0.9 \pm 0.3	-0.7 \pm 0.1	-0.4 \pm 0.1
Student's t value ($n=9$)	0.33 NS	0.40 NS	0.39 NS	1.18 NS	1.52 NS
Gingival bleeding					
Experimental ($n=8$)	4.9 \pm 0.9	-1.4 \pm 0.9	-0.2 \pm 0.7	+0.4 \pm 0.8	-0.1 \pm 0.5
Control ($n=3$)	4.2 \pm 0.3	-0.3 \pm 0.3	+0.5 \pm 0.6	+1.3 \pm 0.4	+0.7 \pm 0.2
Student's t value ($n=9$)	1.36 NS	2.12 NS	1.70 NS	1.84 NS	2.64*

$-$ indicates a lower score than baseline score; NS=not significant; * $P<0.05$.

pating schools were visited once every 2 weeks for follow-up and from then on on an occasional basis. The follow-up visits revealed delays in the start of the programme. These delays were probably caused by the insecurity of the teachers who still felt unfamiliar with oral health issues in the school class. After 4 weeks all eight selected participating schools had finally initiated the whole OHE programme including songs pertaining to oral health.

Before the implementation of the OHE programme, a baseline oral examination was carried out. Follow-up examinations were carried out 3, 8, 15 and 36 months later. Since the programme was carried out in grade 4 only, the last two examinations were performed 5 and 26 months after the children had completed the programme.

Participating children

In each of the eight selected participating schools and four control schools, 50 children in grade 4 were randomly selected. The children were 9–14 years of age. From a total of 400 children at baseline in participating schools, 91 dropped out during the course of the study. In control schools, 200 children were examined at baseline. One control school ($n=50$) had to be withdrawn from the study since the school had started a similar OHE programme on its own initiative. Of the remaining 150 control children at baseline, 28 dropped out. Most drop-outs were caused by transfer to other schools. Some were due to illness or because they were moved back to a lower grade. Thus 309 children from the participating schools

and 122 from control schools were included in the analysis.

Oral examination

All examinations during the entire course of the study were carried out by one examiner (LM) with a probe and a mirror under natural daylight. The examiner did not know which schools were the controls. Plaque was scored as '0' if no soft deposit was present on the probe after scraping over the tooth surface along the gingival margin and as '1' if soft deposit was visible on the probe. Soft deposit directly visible along the gingival margin was scored as '2'. The gingival condition was scored as '1' if bleeding followed gentle probing of the gingival margin and as '0' if bleeding did not occur. Calculus was assessed by running a probe from the supragingival area to the subgingival area over the surface of the tooth. Absence was scored as '0' and presence as '1'. Caries was diagnosed according to WHO criteria (10).

Plaque, gingival bleeding and calculus were assessed at the buccal and mesio-buccal sites of the 1.6, 2.1 and 2.4 teeth and at the lingual and mesiolingual sites of the 3.6, 4.1 and 4.4 teeth. The selected teeth were the 'Ramfjord teeth' (11), which have been reported to be good representatives of the whole dentition for oral hygiene epidemiologic studies (12). If one of these teeth was missing, an adjacent comparable tooth was examined. Since 12 sites (6 teeth, each tooth 2 sites) were recorded, the maximum scores for plaque, gingival bleeding and calculus for a child were 24, 12 and 12, respectively.

Reliability

Blind duplicate examination was performed on 20% of all children to assess intra-examiner consistency for gingival bleeding, calculus and caries scores. There are no indications that probing once for gingival bleeding biases a second gingival bleeding score (13). Duplicate plaque scores were not taken since removal of plaque biases a second score. Cohen's Kappa values (14) of duplicate measurements were calculated at the end of each examination day to stimulate the examiner's motivation to record the scores as accurately as possible. The average Kappa values for gingival bleeding at baseline and four subsequent follow-up examinations were between 0.77 and 0.85, for calculus between 0.86 and 0.92, and for caries at baseline and after 3 years between 0.98–0.99. These results represented a high level of reliability according to the described hierarchical classification (15).

Statistical analysis

Biostatistical arguments for within-subject independence are not convincing (16) and therefore the individual child and not the tooth or site should be used as the unit of analysis. However, in the present study where OHE effects are likely to be dependent on teacher's ability and motivation, specific interactions between a particular teacher and the pupils are likely to occur. To improve the external validity of this study, school instead of child was tested as the unit of analysis.

Effects of gender and age on clinical parameters were isolated as sources of

Table 3. Mean (\pm SD) DMFT at baseline and after 3 years

Schools	Baseline	36 months
Experimental ($n=8$)	0.4 ± 0.2	0.9 ± 0.3
Control ($n=3$)	0.5 ± 0.2	0.9 ± 0.3
Student's t value ($n=9$)	1.12 NS	NS

NS=not significant.

variation by ANOVA. Boys appeared to have significantly more plaque and calculus ($P<0.01$) than girls, and older children exhibited significantly more calculus ($P<0.001$) and caries ($P<0.05$) than the younger ones. The distribution of children by gender and age in participating and control schools was similar and therefore the presence of a bias unlikely. Nevertheless, weighted means of four age-gender subgroups were used in Student's t -test analysis.

Results

Baseline scores of plaque, calculus, gingival bleeding (Table 2) and caries (Table 3) were comparable in participating and control schools. At subsequent follow-up examinations, plaque and calculus but not bleeding scores were consistently lower in both the participating and the control schools. A statistically significant difference between participating and control schools was only found for plaque after 8 months and for gingival bleeding after 36 months. The mean DMFT scores after 36 months were similar in participating and control schools (Table 3).

Discussion

Implementation of this school-based OHE programme in the Tanzanian setting appears to be feasible, provided that the members of the government dental clinic pay regular follow-up visits in the first months after the workshop, otherwise implementation is problematic. This can be concluded from other schools in Morogoro which were not visited for follow-up. Either their performance was poor or they had not initiated any OHE activity at all.

The mean scores of plaque, calculus, gingival bleeding and caries of this child population are in accordance with data from previous studies of Tanzanian children of the same age (4, 17–19). Plaque scores appeared to be con-

sistently lower after baseline. This could not be attributed to last-minute brushing since the children were not forewarned about the examination. Since the calculus scores were also lower after baseline, a shift in the assessment of the examiner's observation might be the explanation for the lower plaque scores after baseline.

The fact that the weekly toothbrushing sessions at school did not improve the oral hygiene along the gingival margin, which was the measured area, may indicate that the teachers did not impart the required skills needed for effective toothbrushing. The widespread presence of calculus acting as a plaque retentive factor in these children may complicate the effective removal of plaque. Another reason for the lack of improvement of oral hygiene may be that these children did not put into practice what they had learned at school because they were not supported at home.

No reduction in caries increment was found in the children of participating schools but this had been anticipated, since previous studies on oral health education (for review, see 20, 21) have shown no reduction in caries increments among the test groups. Besides, it is difficult to achieve a reduction in a population with an already low caries activity.

Intervention studies with school-based oral health education have reported equivocal conclusions regarding the oral hygiene outcome effects (for review, see 20). If positive effects were found, they were limited. Small but statistically significant reductions in plaque and gingivitis scores reported in several studies (22, 23) turn out to be non-significant when, like the present study, schools (small n) rather than the child (large n) are used as the unit of analysis. A contributory factor to the confusion regarding the effectiveness of school-based oral health education is the poor quality of the bulk of studies

pertaining to oral health education (21). To summarize, the oral hygiene outcome effects of school-based OHE programmes, including the present one, are nil or at best very limited.

It can be questioned whether the present school-based OHE programme is cost-effective. On the one hand the extra cost of the workshop was small whereas the follow-up visits were part of the existing field job description of appointed dental personnel in government service. On the other hand the short-term clinical outcome effects were nil. Derived outcome effects such as changes in oral health knowledge and attitude were not evaluated in the present study. Other studies have shown positive effects on knowledge and attitude (23–25). However, these changes do not necessarily directly improve oral health. Once cognitive and affective gains pertaining to oral health have been established at a young age they could later, when the present children become parents, be a factor in improving the health-related behaviour of the next generation. This and the consideration that the (oral) health profession has a responsibility to inform the people about (oral) diseases and their prevention, school-based oral health education should continue to be supported in Tanzania, particularly since the costs are low. In future programmes more emphasis should be put on the teaching of correct toothbrushing skills and on positive parental involvement.

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